



ENSURING FOOD SECURITY IN JHARKHAND THROUGH WATER RESOURCE MANAGEMENT IN THE UPPER CATCHMENT OF DAMODAR RIVER BASIN

Dr. Ifsha Khurshid

Assistant Professor, University Department of Economics, VBU

ABSTRACT

The water resource is extremely crucial for the existence of human race throughout the world. India being the most populous economy is facing challenging situation and have to prepare for the distressing pressure due to water getting scarce in near future. This is not only posing threat to water availability but also to the food security. There are various regions in the country that witness dry spell during a significant part of the year and hence has to prepare in advance to the changing water and food requirement. Along with these two major crisis the erratic weather condition caused by change in climatic condition is also an additional challenge to deal with. Jharkhand is one amongst the drought prone state of the country where several districts are struggling to manage with the available water resource and emerging water requirement.

The Damodar River Basin plays a crucial role in supporting agriculture and ensuring food security in Jharkhand. This region, characterized by its diverse topography and seasonal rainfall, faces significant challenges in water resource management, including erratic monsoon patterns, water scarcity, and pollution from industrial and mining activities. Effective management of the basin's water resources is essential for sustaining agricultural productivity, promoting equitable water distribution, and enhancing the livelihoods of local communities.

This paper explores integrated water management strategies such as rainwater harvesting, watershed development, and sustainable irrigation techniques. It emphasizes the need for community participation, the adoption of modern technologies, and policy interventions to optimize water use and mitigate the impact of climate change. By leveraging these approaches, Jharkhand can secure its agricultural base, address food insecurity, and build resilience against environmental and economic challenges in the Damodar River Basin.

KEYWORDS: Water Resource Management, Climate Change, Food Security

INTRODUCTION

Water plays a critical role in food and land systems, yet conservation practices in agriculture often go overlooked. With 72% of global water resources dedicated to food production, the growing scarcity of water threatens the sustainable production of food. If we understand the concern of the crisis that will hit the global mass is the scarcity of food and water and they are inextricably linked and only due to water being scarce and erratic climate change the problem of food security will also be one of the major concerns with the rapid population growth. We are not ready for facing the challenge of dealing with water and food crisis along with facing the thrash of climate change simultaneously. By 2050, an estimated 80 million people may face hunger due to water shortages and erratic climate conditions. This growing demand for food and water intensifies the imbalance in the hydrological cycle, exacerbating the global water crisis.

Table 6.1.2 : Water Availability in India		
Sl.No	Items	Quantity
1	2	3
1	Annual Precipitation (including snowfall)	4000 BCM
2	Average Annual Availability	1869 BCM
3	(i) Per Capita Water Availability (2001) in cubic metres	1816Cu.M
	(ii) Per Capita Water Availability (2010) in cubic metres	1588Cu.M
	(iii) Per Capita Water Availability (2015) in cubic metres	1720.29Cu.M
	Estimated Utilizable Water Resources	1123 BCM
	(i) Surface Water Resources	690 BCM
4	(ii) Ground Water Resources	433 BCM

Source: Central Water Commission-2015
BCM : Billion Cubic Meter. Cu.M - Cubic Meter.

Table 6.1.1 Projected Water Demand in India (By Different Use)									
Sector	Water Demand in BCM(Billion Cubic Meter)								
	Standing Sub-Committee of MOWR			NCIWRD					
	2010	2025	2050	2010		2025		2050	
				Low	High	Low	High	Low	High
Irrigation	688	910	1072	543	557	561	611	628	807
Drinking Water	56	73	102	42	43	55	62	90	111
Industry	12	23	63	37	37	67	67	81	81
Energy	5	15	130	18	19	31	33	63	70
Other	52	72	80	54	54	70	70	111	111
Total	813	1093	1447	694	710	784	843	973	1180

Source: Basin Planning Directorate, CWC, XI Plan Document.
Report of the Standing Sub-Committee on "Assessment of Availability & requirement of Water for Diverse uses-2000"

Note: NCIWRD: National Commission on Integrated Water Resources Development
BCM: Billion Cubic Meters
MOWR: Ministry of Water Resources.

If we look into the detail of Key geographical statistics of Jharkhand we find that

- **Jharkhand's agricultural land:** 29.74 lakh hectares of the state's 79.72 lakh hectares.
- **Irrigation potential:** 12.765 lakh hectares (major and medium schemes) and 16.975 lakh hectares (minor irrigation).
- **Catchment area of Damodar River Basin:** Approximately 25820 km², with three-fourths in Jharkhand.
- **Reservoir storage:** 419 million cubic meters (mcm), primarily for industrial and domestic use.

Table 6.2.4 : List of districts with deficient or scanty rainfall

March-May 2015

MET. Sub Division 1	Districts 2	MET. Sub Division 1	Districts 2
Arunachal Pradesh	Changlang Dibang Valley East Kameng Tirap	Bihar	Jahanabad Monghyr Nawada Patna Saharsa Sheohar Sitamarhi
Assam & Meghalaya	Jaintia Hills Karimganj N.C. Hills Nagaon	East Uttar Pradesh	Kushi Nagar
Nagaland, Mizoram, Manipur and Tripura	Lungle Mamit Saiha Phek Wokha Chandel	Jammu and Kashmir	Ladakh (Leh)
Sub-Himalayan West Bengal & Sikkim	Imphal East Thoubal Senapati Kolasib	Gujarat	Panchmahal Tapi
Odisha	West Sikkim South Dinajpur	Maharashtra	Mumbai Suburban
	Angul Cuttack Jagatsinghpur Balasore Jharsuguda Kendrapara Bolangir Boughgarh Gajapati Ganjam Kandhamal Keonjhar Khurda Sundargarh	Dadra & Nagar Haveli Daman & Diu	Jamnagar Surendranagar
		Coastal Andhra Pradesh	East Godavari Vishakapatnam Vizianagaram West Godavari
		Jharkhand	Guntur Krishna Prakasam Srikakulam
		Chhattisgarh	Chatra Simdega
		Gangetic West Bengal	Kowardha Jashpur Narayanpur Raigarh
			Hooghly South 24 Parganas

Source: Indian Meteorological Department

In Jharkhand, the Damodar River Basin exemplifies the urgent need for integrated water resource management to address the challenges of food security in a rain fed region set up of the state's agriculture. The Damodar River Basin supports about 8% of India's population, spanning Jharkhand and West Bengal. Originating in the Chotanagpur Plateau, the river provides drinking water, irrigation, and industrial supply. However, industrial activities and population migration have strained its resources, degrading water quality and quantity. The Damodar river serves as a vital source of drinking water, irrigation, and industrial supply for the region. However, the concentration of industrial activities along its banks has led to population migration into certain areas, intensifying pressure on water resources. This increased demand has adversely affected both the quality and quantity of water, threatening the river's natural self-purification capacity in several stretches.

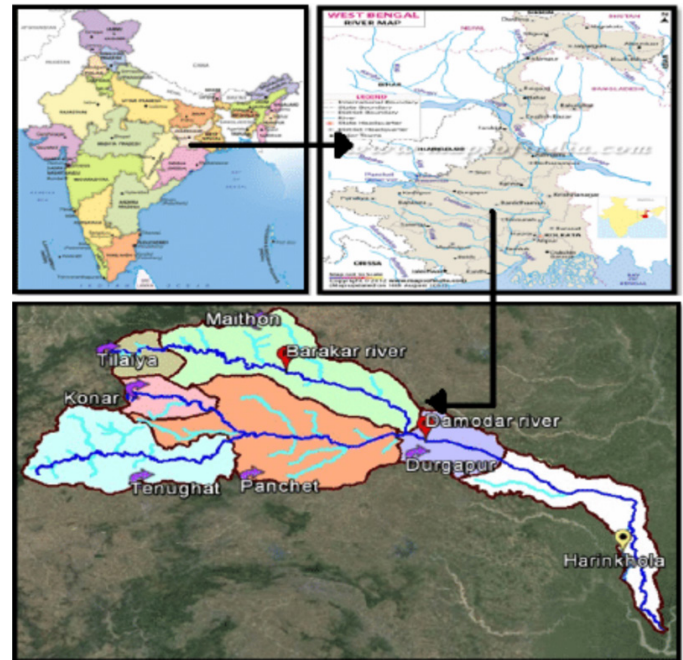


Table 6.5.5 : River-basin wise distribution of water quality monitoring stations

Sl. No.	River (main stream) Lake etc.	Tributaries	Total Stations
1	2	3	4
1	Baitarni (5) Tributaries -Kusei (1)	-----	6
2	Tributaries	Karo (1) Kharasrota (2), Koel (5), Sankh (1).	25
3	Brahmaputra (10) Tributaries	Burhidihing (3), Dhansiri (7), Disang (2), Jhanji (1), Subansiri (1), Bhogdoi (1), Bharalu (1), Borak (2), Deepar Bill (1), Digboi (1), Mora Bharali (1), Teesta (5), Dickhu (1), Maney (2), Ranchu (2), Rangit (5), Jai Bharali (1), Kathakal (1), Kharsang (1), Kolong (2), Manas (1), Pagdia (1), Chathe (1), Dzu (1), Kapili (1), Beki (1), Kundil (1), Kushiara (1), Panchnai (1), Sankosh (1), Sonai (1), Kohara (1), Ranga (1), Bogindal (1), Dikhow (1), Kaljani (1), Karola (1)	68
4	Cauvery (20) Tributaries	Arkavati (1), Amravati (1), Bhawani (5), Kabini (4), Laxmantirtha (1), Shimsa (2), Hemavati (1), Vagachi (1)	36
5	Ganga (52) Tributaries	Alakananda-upper Ganga (4), Madakini -upper Ganga (1), Ajay (1) Ashwani (1), Barakar (2), Batta (2), Betwa (10), Bhalla (2), Bichia (1), Bihar (1), Bokaro (1), Burhi Gandak (1), Chambal (8), Churni (3), Doha (3), Damodar (12), Dhela (2), Dhous (1), Dwarakeshwari (1), Dwarka (2), Farmer (1), Gandak (3), Giri (3), Sot (1), Kamala (2), Kanshi (1), Khan (3), Kichha (1), Kolar (1), Konar (3), Koshi (2), Kosi (Uttarakhand) (1), Kshipra (3), Mahananda (3), Mandakini (Madhya Pradesh) (1), Manusmar (1), Matha Bhanga (1), Maurakshi (1), Nalkari (1), Nandaur (2), Pabbar (3), Parvati (4), Pilkhar (1), Ramganga (1), Ram Rekha (1), Rapti (2), Rihand (2), Ruppenarayan (2), Sai (2), Sankh (1), Silabati (1), Sindh (1), Sirsa (1), Saryu - Ghaghra (4), Sone (5), Suswa (1), Tons (Himachal Pradesh) (1), Tons (Madhya Pradesh) (2), VAruna (2), Vindiyadhri (2), Yamuna (27)	233
6	Godavari (35) Tributaries	Manjira (6), Maner (2), Nira (1), Wainganga (8), Wardha (6), Kolar (1), Kannhan (3), Purna (3), Indravati (2), Sankhani (1), Nakkavagu (1), Vamsadhara (1), Darna (5), Bindusar (1), Penganga (3), Wena (2), Kinnersani (1), Sabari (1)	83
7	Indus	Beas (23), Chenab (1), Jhelum (3), Larji (1), Parvati (3), Ravi (6), Sutlej (22), Tawi (1), Gawkadal (1), Chuntkol (1), Sirsa (3), Swan (1), Basoa (1), Binwa (1), Negual (1), Siul (1), Spiti (1), Suketi Khand (1)	72
8	Krishna (22)	Bhadra (3), Bhima (12), Ghataprabha (2), Malprabha (3), Muneru (1), Musi (3), Nira (5), Paleru (1), Tunga (1), Tungabhadra (6), Panchganga (4), Chandrabhaga (2), Kagin (1), Koya (1), Mula (2), Mutha (4), Mula-Mutha (2), Venna (3), Pawana (6), Indrayani (3), Hundri (1), Kundu (1), God (1), Sina (1), Urmodi (1), Vel (1)	93
9	Mahi (9)	Anas (1), Panam (1), Jammer (1), Malei (1), Shivna (1), Chillar (1)	15
10	Mahanadi (22)	Ib (4), Hasdeo (2), Kathajodi (1), Kharoon (4), Kuakhai (3), Sheonath (3), Birupa (1), Apra (1), Kelo (2), Bheden (1), Tel (1), Serua (1), Daya (1), Sankha (1)	48
11	Narmada (21)	Chhota Tawa (1), Gour (1), Katni (1), Kunda (1)	25
12	Pennar (5)	----	5
13	Sabarmati (9)	Meswa (1), Shedhi (1), Khari (1).	12
14	Subarnarekha (12)	Jumar (1)	13
15	Tapi (14)	Girna (2).	30

Source: mospi.gov.in

Observations indicate that approximately three-fourths of the basin lies within Jharkhand, with the remaining one-fourth in West Bengal. The basin's total catchment area is reported to be 25,820 km² (DVC, 1992). However, the Central Pollution Control Board (CPCB) has delineated the catchment area as 23,170 km², distributed among the sub-catchments as follows:

1. Main Damodar River: 15,280 km²
2. Barakar Tributary: 7,025 km²
3. Bokaro–Konar Tributaries: 865 km².

Table 1. Saliient features of the Damodar valley

Name of dam and river stream	Catchment area (miles ²)	Dead storage (acre feet)	Conservation storage (acre feet)	Flood storage (acre feet)	Installed capacity of power house (MW)
Tilaiya: Barakar	380	60,680	114,800	143,900	4
Maithon: Barakar	2430	168,090	495,540	446,370	3 × 20
Konar: Konar—tributary of Damodar	385	49,530	178,770	216,370*	—
				44,200	
Panchet: Damodar	4234	148,060	184,930	881,000	1 × 40
				277,000*	
Total for DVC	7430	426,400	974,000	1,515,500	
				681,470*	
Tenughat: Damodar	1730	170,000	621,100	—	—

* Flood storage available with land acquisition upto RL 495 and RL 425 in Maithon and Panchet reservoirs respectively; RL—reduced level

The industrial and mining activities in the region have led to significant soil erosion and environmental pollution, transforming the Damodar River from the “river of sorrow” into a “river of agony” due to severe contamination. The Indian industrial sector heavily relies on this region, with 60% of the coal consumed by the country's industries sourced from the Damodar Basin. Furthermore, coal from this area is indispensable for power generation in Jharkhand and West Bengal. The catchment area of the Damodar River Basin spans between 22° 45'N to 24° 30'N latitude and 84° 45'E to 88° 00'E longitude, encompassing parts of Jharkhand and West Bengal. It covers approximately 11.8% of Jharkhand's and 8.6% of West Bengal's total geographical areas. The basin's drainage area includes Hazaribagh, Ramgarh, Koderma, Giridih, Dhanbad, Bokaro, and Chatra districts in Jharkhand, as well as Burdwan and Hooghly districts in West Bengal. Additionally, it partially extends into Palamau, Ranchi, Lohardaga, and Dumka districts in Jharkhand, and Howrah, Bankura, and Purulia districts in West Bengal.

The main **Challenges** related to the dry spell drought and urgent requirement of water conservation practices are in the Upper Damodar Basin are mostly faced by the upper catchment area that lies in Jharkhand which are:

- **Erratic rainfall:** Annual precipitation of 1200-1400 mm, insufficient for consistent agriculture.
- **Groundwater overdependence:** Poor surface water management has led to excessive groundwater extraction, lowering water tables.
- **Soil erosion and low fertility:** Mining and deforestation have reduced groundwater recharge and degraded soil quality.

These issues significantly affect agriculture, making the population vulnerable to water shortages, drought, and reduced

crop yields for the significant part of the year, while these led to incur situations like drought that strains the farmer's ability to sustain the production of crop and manage live stocks. On the contrary there are also incidences of floods during the rainy season that are triggered by tropical cyclones and increased rainfall also pose threat to the sustainability of agricultural production and live stocks. There is an urgent need of essential climate-smart water management system that can address the water requirement of urban areas, mange the problem of over-extraction and deteriorating water quality which collectively threatens the resilience of small-scale farmers and rural communities. The upper Damodar River catchment is highly prone to soil erosion, influenced by factors such as slope, rainfall intensity, soil properties, and vegetation cover. Erosion is particularly severe around the catchment areas of the five reservoirs, leading to wasteland formation, reservoir siltation, and reduced storage capacity. Continuous sediment transport to the lower valley has progressively raised the riverbed over time, exacerbating the issue (Ghosh, 2014).

The basin has faced significant flooding, historically known as the “Sorrow of Bengal.” Floods caused widespread devastation, with records of peak flows exceeding 8,496 cumec. To mitigate these challenges, the Damodar Valley Corporation (DVC) was established in 1948, modeled after the Tennessee Valley Authority. It implemented multipurpose infrastructure, including dams at Tilaiya, Konar, Maithon, Panchet, and Tenughat, and a barrage at Durgapur. These projects significantly reduced flooding and created irrigation potential for 3,640 km², benefiting districts in West Bengal and Jharkhand.

Proposed Solutions: An integrated approach is essential for flood prevention and water pollution control in the Damodar Basin. Key measures should include regulating untreated effluent discharge from mines, industries, and urban areas, alongside large-scale reforestation, soil conservation, water conservation, and storage initiatives across the catchment area. Effective management of monsoon flows and maintaining adequate non-monsoon flow levels are crucial to balancing river ecology and reducing pollution.

Integrated Water Resource Management: An integrated approach is essential for sustainable water use and pollution control. Measures include:

1. **Reforestation and Soil Conservation:** Large-scale afforestation and erosion control to improve water retention.
2. **Water Conservation Projects:** Minor irrigation schemes tailored to Jharkhand's geography, ensuring timely project completion and benefits for farmers.
3. **Pollution Control:** Regulating industrial and urban effluent discharge.
4. **Flood Management:** Effective use of reservoirs to moderate monsoon flows and maintain non-monsoon river ecology.

Technological Interventions

1. **Real-Time Monitoring:** Use technology to track water

storage, usage, and availability.

2. **Data-Driven Agriculture:** Pilot programs like those in Maharashtra and Uttar Pradesh, integrating crop, weather, and market information to improve productivity with minimal water usage.
3. **Wastewater Treatment:** Public-private partnerships to establish treatment plants, providing irrigation water and improving agricultural incomes.

Infrastructure Development

1. **Water Storage:** Dams, barrages, and storage facilities to regulate water supply for agriculture and industry.
2. **Agricultural Infrastructure:** Warehouses and treatment plants to improve soil health and productivity.
3. **Land Use Planning:** Optimize land allocation for agriculture, forestry, and urban development.

There must be a proper mechanism to keep track record of water source and water storage system in the locality. There should be proper infrastructure to store farm produce like warehouses to store fresh produce to be kept safely before they meet the potential buyer at the right time and right price. There should be proper planning and allocation of land use pattern in the area or locality to make sure every piece of land may be utilized efficiently and effectively in their best possible way. Proper infrastructure is needed for ensuring maximum productivity from the soil with minimal water use this may also need treatment plants for improving the soil health.

The farm boundaries should be properly defined as per the need of the water requirement so that a proper trade between water for food could be done keeping in mind the changing weather conditions. There must be tailored analysis of weather predictions, water storage, water usage and enabling real-time forward-looking decisions that can drive progress in the food and water sectors both.

CASE STUDIES

- **Maharashtra's Agricultural Development Trust:** Collaborated with Microsoft, Oxford University, and Click2Cloud, achieving a 20% increase in production with 8% less water.
- **Uttar Pradesh's 2030 Water Resources Group:** Improved rice and sugarcane yields with reduced water usage through technology-driven interventions.

This has led to 20% increase in production with 8% less usage of water resource in Maharashtra and has enabled the increased production of rice and sugarcane crops in Uttar Pradesh with lesser use of water. All these will not only help in promoting the agricultural produce but will also develop more refined policies for better allocation of resources. These successful examples of pilot surveys conducted in Maharashtra and Uttar Pradesh gives a clear idea of mixing technology and human wisdom to benefit farmers, stakeholders and the private sectors. The initiative should involve farmers, their indigenous wisdom, as by collaborating with the local population and involving them in identifying the region-specific problems and their solutions, it becomes adaptable, scalable and aligned with regional needs.

This is the right time to keep track and record various resources of water supply. Using various technological methods that will not only help us to keep a record of our existing resources but will also help us to compare the increase or decline in the water resource. Despite of the fact that every country has its own food and water system, but each country and region have its own strategy to deal with the issue of water and food scarcity. Keeping in mind the increasing need of increasing food and water requirements it is important to harness nature and develop innovative methods to adopt collective analysis to deal with the dual problem of water and food along with the rapid change in climate.

There is a dire need to understand the importance of water resource and improve the water management especially in production of food to secure the resources for future population on the planet. It requires an increased focus on the efficient irrigation set up combined with various farmer-led approaches to adopt regenerative agriculture set up that can back up the entire food chain. This is possible only when the improved water management set up is linked with the food value chain which will help to deal with food security across the nations by providing adequate nutrition and will help to protect the livelihood of the farmers. It is no more an agenda to discuss rather it is a harsh reality that we are witnessing that water plays an integral role in global economy whether its food system or beyond. It plays a very important role for the ensuring the existence of human race on the planet. Therefore, it become very important for the policy makers to focus on policy and decision making targeting these acute problems and keep a track of trends of these resources with the help of latest technologies throughout the world. We are left with no time to opt for trial-and-error experiments and any inefficiency that is caused by any fragmented decision making in a region will cause a greater impact beyond its periphery.

Recommendations for Policy and Infrastructure Development

1. **Water Resource Monitoring:** Maintain detailed records of water storage, usage, and recharging channels to predict and mitigate scarcity.
2. **Land Use Planning:** Optimize land allocation for agriculture and other uses, ensuring minimal environmental degradation.
3. **Infrastructure Development:** Build warehouses and treatment plants to support agricultural productivity and improve soil health.
4. **Inter-Basin Water Transfers:** Redirect surplus water from the Damodar-Barakar basin to deficient areas, addressing regional disparities in water availability.

CONCLUSION:

Water management is vital to food security in Jharkhand, especially in the Damodar River Basin. A climate-smart water management system can:

- Stabilize agricultural output by addressing erratic rainfall.
- Enhance resilience against climate impacts.
- Secure consistent farm incomes through efficient irrigation and resource allocation.

Agriculture in the Damodar River Basin varies between its upper and lower catchments due to differences in soil, water, and climate. The upper catchment Jharkhand receives an annual rainfall of 1200-1400 mm, which supports irrigation for agriculture. However, erratic rainfall and irregular weather patterns driven by climate change have recently disrupted farming and harvesting in the state. As climate variability intensifies, Jharkhand is likely to face increased rainfall irregularities, leading to uncertainties in agricultural production. Effective water management, along with monitoring water usage and requirements, can enhance resilience against climate impacts and stabilize agricultural output.

Proactive water management can ensure consistent farm income by supporting regular crop production. Since irrigation is costly, farmers need to consider factors like climate, soil health, pest and disease prevalence, market fluctuations, financial conditions, and emerging technologies to identify cost-effective irrigation solutions. Access to a stable water supply will help farmers make informed decisions to improve productivity in a changing environment. Collaboration among local farmers, researchers, and extension workers is essential for maintaining detailed records and tracking area-specific water needs.

Jharkhand relies on rain-fed crops like rice, maize, millets, pulses, and oilseeds, but productivity is hindered by limited water resources and rocky soils. In contrast, the lower catchment (West Bengal) benefits from fertile alluvial soils and DVC-supported irrigation, enabling the cultivation of irrigated rice, jute, sugarcane, vegetables, and wheat. This disparity makes agriculture in the upper catchment less reliable compared to the more productive lower catchment. This contributes widely to the employment, income and exports of the state.

Collaboration among local farmers, policymakers, and researchers is key to aligning solutions with regional needs. By integrating traditional knowledge with modern technology, Jharkhand can address water scarcity, improve agricultural productivity, and ensure food security for future generations. Effective water resource management in the Damodar Basin is pivotal for Jharkhand's food security. By integrating advanced technologies, sustainable agricultural practices, and inclusive policy-making, Jharkhand can build resilience against climate-induced challenges. Collaborative efforts among farmers, researchers, and policymakers will ensure efficient resource use and bolster agricultural output, securing livelihoods for millions dependent on the basin.

REFERENCES

1. Bhattacharyya K (1999) Floods, flood hazards and hazard reduction measures: a model—the case in the lower Damodar River. *Indian J Landscape Syst Ecol Stud* 22:57–58
2. Bhattacharyya K (2011) *The lower Damodar River, India: understanding the human role in changing fluvial environment*. Springer, New York
3. Chandra D (1992) Mineral resources on India 5: Jharia coal elds. Geological Society of India, Bangalore, India, p 149
4. Chandra S (2003) India: flood management—Damodar River basin. Retrieved from www.apfm.info/pdf/case_studies/cs_india.pdf

5. CMRI (2001) Carrying capacity of Damodar River basin- existing scenario, vol I. Central Mining Research Institute, Dhanbad, India, p 136
6. DVC (1992) *Damodar Valley: evolution of the grand design*. Damodar Valley Corporation, Kolkata
7. Ghosh S (2013) Estimation of flash flood magnitude and flood risk in the lower segment of Damodar River basin, India. *Int J Geol Earth Environ Sci* 3:97–114
8. Ghosh S (2014) The impact of the Damodar valley project on the environmental sustainability of the lower Damodar basin in West Bengal, Eastern India. *Int J Sustain Dev* 07:47–53
9. Tiwary RK (2001) Environmental impact of coal mining on water regime and its management. *Water Air Soil Pollut* 132:185–199
10. Sen PK (1991) Flood hazards and river bank erosion in the lower Damodar Basin. In: Sharma HS(ed) *Indian geomorphology*. Concept Publishing Company, New Delhi, pp 95–108